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ABSTRACT

This paper discusses methodologies which allow in-depth exploration of usage patterns and preferences in screen-based computer-mediated communication (CMC). The paper, which focuses on usage by the general public, is divided into five parts. The first part discusses the growth trends and special characteristics of CMC in comparison to other electronic communication technologies. The research challenges posed by CMC, particularly in contrast to research on mass communications, are examined in the second part. The next part describes the simulation-based experimental methods developed and employed by the authors to study CMC, including Infoserve, the software system used as a simulation mechanism; content choices provided; examples of manipulations of presentations used in experiments; online and offline measures of subjects' choices; illustrations of results; and potential new analyses. The fourth part discusses the advantages and limitations of simulation-based experiments for researching CMC; and the final part offers brief concluding comments, including an outline of future research directions. A list of the 10 topics and related subtopics used in experiments, a table comparing communication technologies, and figures depicting software and system architecture are appended. (Contains 16 references.) (KRN)

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Using Simulation to Investigate the Use of Computer-Mediated Communication

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Using Simulation to Investigate the Use of Computer-Mediated Communication

ABSTRACT

This paper discusses methodologies which allow in-depth exploration of usage patterns and preferences in screen-based computer-mediated communication (CMC). After discussing the growth trends and special characteristics of CMC in comparison to other electronic communication technologies, research challenges posed by CMC are contrasted with conventional mass communication research. The paper then describes the online, simulation-based research methodology developed and employed by the authors to measure actual user behavior, and identify topic preferences and usage paths. Advantages and limitations of simulation-based experiments as a technique for researching CMC are discussed.

INTRODUCTION

After the false starts and setbacks of the 1960s and 1970s, mass-scale computer-mediated communications (CMC) seem to be poised for substantial growth in the 1990s and beyond. A number of factors are driving such growth. Widespread availability of desktop computers, an increasing proportion of which are networked, has increased the familiarity and comfort levels of office workers with CMC. Technological revolutions in telecommunications are making it possible to use phone lines for data transmission, leading to mass-market phone-based CMC networks such as *Teletel* in France. Wireless technologies for CMC, cellular networks and interactive TV for example, are poised for a takeoff.

As CMC technologies move beyond the office into the mass arena, the need for conducting systematic research on user acceptance and social impact of such technologies is intensifying. This paper reports on the use of simulation-based experiments as a versatile research technique for studying computer-mediated communication.

This paper focuses on the category of CMC known as screen-based information services. Although much has been written about these services, there has been little published research measuring actual user behavior, and identifying topic preferences and usage paths. The paper discusses methodologies which allow in-depth exploration of

usage patterns and preferences in screen-based computer-mediated communication.

The paper is divided into five parts. The first part discusses the growth trends and special characteristics of CMC in comparison to other electronic communication technologies. The second part examines the research challenges posed by CMC, particularly in contrast to research on mass communications. The third section describes the simulation-based experimental methods developed and employed by the authors to study CMC. The fourth part discusses the advantages and limitations of simulation-based experiments as a technique for researching CMC. The final section offers brief concluding comments, including an outline of future research directions.

SCREEN-BASED SERVICES: TRENDS AND SPECIAL CHARACTERISTICS

Evolution of Screen-based Services

With limited growth prospects for additional voice-based telecommunications services, there is rising interest in exploring the potential for screen-based technologies. These include types of computer-mediated communication as well as video-based communications which might get computerized in the future through digitization. Screen-based information services have attracted particular attention because they represent not only an improved and alternative transmission technique to traditional telephone and television, but also provide the means to link large

numbers of information providers and receivers in flexible and interactive formats.

From the launch of Prestel videotex service in Britain in the late 1960s, the range of information and communication services available to residential consumers and business users in the technologically advanced nations has been growing (Greenberg, 1989). In Europe, information services delivered through television sets or specialized terminals, such as *minitel* in France, have made some headway (Brooker, 1988; Dupagne, 1990; Grenier, 1989; Purton, 1988). In the United States, services delivered through TV or special terminals have not made much impact; instead, such services have been associated with home computers (Antonoff, 1989; Vitalari 7 Venkatesh, 1987). Those who study the technological capabilities and possibilities of computers and telecommunications claim that the mere threshold of this unfolding universe of "tele-delivered" services has been reached thus far (Gilder, 1991).

In a competitive and fragmented communications environment such as the United States, demand-side factors play a far more significant role than they do in state-led communications environments such as France or Singapore (Sisodia, 1991). In deregulating and competitive environments, user acceptance of information technologies cannot be understood without careful study of how users respond to various communication and information formats and attributes.

Prospects of Screen-based Services

Commercial types of computer-mediated communication offer the use of electronic mail along with electronic banking, shopping, entertainment, and information services. These systems have often been referred to as "videotex" in the past. Although -- as in the French Minitel system -- E-mail is one of the most popular services (besides some frivolous forms of entertainment), the use of other functions will increase as their intrinsic and external benefits gain public recognition, and as they reach the critical mass making them commercially viable.

The climate for screen-based information services has been changing rapidly in the United States in recent years (Antonoff, 1989; Schlossberg, 1991). For the average user, technical capabilities of communication and computer systems have by far exceeded the level of what is needed in terms of functionality ("I can't work," 1991; Rooney, 1991). Under these conditions, users gravitate towards simple and basic applications. Venkatesh and Vitalari (1987) found, for example, that people tend towards simpler computer applications than they had initially intended.

Appealing to non-experts is particularly important for screen-based information services such as videotex. Such services are often designed to take the place of established and familiar information and communication technologies (phone, TV, newspapers, magazines) or face-to-face interaction. To many potential users the advantage of the

new over the old technology is not necessarily evident. Getting used to the new technology is often perceived as an inconvenience. Potential benefits do not outweigh the perceived negatives.

A dimension which is often overlooked by providers of computing and information products and services is the entertainment quality of such a service. Assuming that most non-experts are able to satisfy their information needs adequately without such new services, one should expect increases or shifts in media usage to be a function of the entertainment capabilities of the technology or software employed.

Television serves as a major illustration of this assumption. A glance at television and radio audience figures reveals that entertaining materials take up by far the greatest share of programming watched or listened to (MacFarland, 1990). By analogy, one might expect that the entertainment quality of new information technology, in terms of content and format, will be a critical determinant of user acceptance.

Special Characteristics of CMC

Computer-mediated communication has been typically thought of as some variation of electronic mail, which in turn is two-way communication. Traditionally, electronic mail was used by scientists, engineers and others with easy access to a mainframe computer, and by personal computer users on a network. Access to the general public was often

provided through video-type information services. To date, the most successful example of publicly available CMC is the French *Teletel* system, which uses dedicated terminals called *Minitels*. Besides the electronic telephone directory (the original starting point of *Teletel*), electronic messaging is the most frequent activity, although other information services are gaining popularity. Also, PC-based U.S. information services such as *Prodigy* provide a mixture of electronic mail and interactive information services.

Other types of computer-mediated communication are closer in nature to mass communication in that messages are distributed and potentially available to thousands of users. In quantitative and content terms, though, these services fit the concept of narrowcasting rather than that of broadcasting.

Compared to the conventional communication technologies such as television, radio, and the telephone, computer-mediated communication (CMC) has a number of unique characteristics. CMC can be interpersonal, small group, or mass communication. It usually takes place in an asynchronous time framework. Selective targeting by the sender and receiver can be much greater than in any mass communication medium. The sender has little control over selective exposure. Messages can be easily manipulated, modified, stored, and edited by the sender and to some degree by the receiver. Each interaction tends to be unique as compared to a mass communication situation. These and

other key differences between CMC and other main electronic communication technologies are summarized in Table 1.

Table 1 About Here

A key feature of future developments of CMC will likely be the merger of elements of telephone, computers, and television technologies. As a result, CMC will be on a continuum between interpersonal and mass communication. Salvaggio (1986) points out that different social effects are to be expected for newer communications technologies compared to traditional mass communication systems. Specifically, he argues that: (a) While mass communication effects result from exposure to communication, or lack thereof, new communication technologies are related to transformations in society as a whole (e.g., increases in telecommuting); (b) Reception processes are heterogeneous for CMC vs. homogeneous for mass communications. It will be less common in the case of the newer technologies that large groups of people will view the same message at the same time; (c) Mass communication tends to be passive, while newer technologies are active, not only in permitting greater selectivity, but often providing options for the user to interact with the system; (d) Users are less likely to be affected by the content of the communication than by the way they use it. Consequently, research approaches

different from those employed in mass-media research are necessary when investigating new information technologies.

RESEARCH ISSUES AND CHALLENGES

Need for Systematic Research

Whether the perspective is that of companies marketing CMC services or of users of CMC services, it is imperative to understand how users interact with these new electronic media. It is also important to understand how different types of users perceive, accept, and employ these services and whether there are inherent biases in these technologies in favor of or against some categories of users. While research of a commercial nature undoubtedly precedes the introduction of many new CMC technologies, academic research that provides a dispassionate assessment of such technologies is scarce and in its infancy. One constraint holding back such research is the lack of appropriate research methods and measurements. A starting point is to examine the research traditions employed in the study of mass communication media and to assess what the special characteristics of CMC imply in terms of applicability of mass communication research techniques.

Contrast with Mass Communication Research

Conventional mass communication research has generally assumed some variation of a one-way communication model, recently with some selectivity on the part of the audience.

In computer-mediated communication, the key process is not so much the content, as it is the interaction of content and selection processes. Unlike television or movie-based selective exposure research, selectivity in a computer-based communication system is not simply a measure of liking or enjoyment; it is actually part of the communication process. For example, anecdotal evidence based on interviews of the French *teletel* system users indicates that some users get so involved with some of the games on the network that they run up astronomical telephone bills. In this context selecting a particular topic is not only a measure of how much the user enjoys that topic but it also defines the user's very relationship to the *teletel* system, bordering on addiction in some cases.

Traditionally, experimental research on responses to the electronic media has been characterized by two clearly limiting features: measurement took place offline and ex-post (i.e., responses were recorded after subjects had completed viewing), and exposure was forced (i.e., subjects were assigned to viewing conditions and had no choice in the materials they watched). Anderson and Field (1991) discuss online vs. offline assessment of the television audience, and identify three key problems of offline measurement:

(a) The validity of offline research is usually unknown. Respondents often simply don't remember what they watched (as in ratings research), or their

responses may be distorted after they have gone through an entire viewing session.

(b) Offline is best used to measure relatively enduring behaviors and traits of which the respondent has some conscious awareness (p. 201).

(c) The questions asked in offline research often require interpretation by subjects. The need to understand the questions might already interfere with accurate responses. Also, different subjects will interpret the same question differently.

Based on these shortcomings, online measurement would have to be considered superior as a research methodology. There are, however, problems with online research, as well. Often, as with Peoplemeters, subjects are acutely aware of the measurement taking place, and they have to take some action (such as pushing buttons). Awareness of measurement taking place might influence viewing behavior and reliability of button-pushing will vary over time and across subjects. Academic and commercial researchers have attempted to design measurement techniques which circumvent these problems (cf. Beville, 1988).

A related issue pertains to the mode of exposure. In traditional experimental research on electronic media, subjects assigned to a particular exposure condition view a predetermined, specific video clip or sequence of video clips. This viewing situation lacks ecological validity, especially in today's multichannel, remote-control

environment. One should assume that subjects who select a program will respond differently towards it compared to those who -- if given a choice -- wouldn't have selected this particular program.

Commercial research has employed a number of offline and online techniques to assess exposure. The diary is the most common offline instrument. For a long time, online measurement was limited to the Nielsen Audimeter which registered only household viewing of particular programs, and sometimes merely the fact that the television was turned on. Recently, Peoplemeters have opened up opportunities for individual-level measurement. Peoplemeters currently in use are still "active," however, i.e., viewers have to push buttons at regular intervals.

In terms of research validity and control, these commercial techniques have two major limitations:

(a) Users are aware of them, and have to become active, thereby introducing demand characteristics in the measures obtained.

(b) The researcher has no control over the choices available to the viewer. This is particularly problematic in a multi-channel environment.

Some researchers have devised procedures combining the greater ecological validity of selective exposure research with the need for controlled stimulus conditions. For instance, Zillmann and Bryant (1984) conducted a study determining subjects' choices from a controlled set of six

alternative programs. Three of these had been judged beforehand as being exciting, and three as relaxing. Exposure was measured unobtrusively by an electro-mechanical device. Subjects' mood (boredom vs. stress) had been previously manipulated. Rather than using the conventional approach of assigning subjects to stimulus conditions (exciting vs. relaxing fare) within mood conditions, the researchers let the subjects determine what they felt like watching. This approach provided a much greater degree of external validity. As Webster and Wakshlag (1986) conclude, "studies that use forced exposure do little to enhance knowledge about whether such effects happen under normal circumstances which allow selective exposure."

Need for New Research Approaches

Based on the foregoing brief review of research methodology issues pertaining to mass communications, it is evident that research on CMC should be conducted under conditions that permit flexible, selective interaction by the user with a system that realistically emulates the features that a commercial information service may offer. Simulation-based experiments offer a versatile method for researching CMC by allowing a modicum of experimental control under conditions that have a fair amount of external validity. The next section outlines the simulation-based experimental procedure developed and employed by the authors for ongoing studies of user acceptance of screen-based information services.

SIMULATION-BASED EXPERIMENTS

Description of the Method

Overview. In a series of experiments, female and male subjects were exposed to a software simulation of an interactive videotex system. Subjects believed that they were evaluating a prototype of a new commercial information service. The first study varied hedonic features (presence or absence of color, graphics, and music) of the information service. In the second study, variety of information, and amount of information provided by the simulated information service were manipulated. Each subject's keystrokes and choices were recorded and timestamped unobtrusively by the software system. At the end of the fifteen minute exposure period, subjects reported their reaction to the system in an exit questionnaire.

The Simulation Mechanism. The various experimental treatments were administered through the use of *INFOSERVE* -- a custom software system that emulates a complete commercial videotex product. The initial system screen presents a professional looking information service logo. This is followed by a screen which provides complete instructions for the experimental user. Next, users are presented with a topics menu screen. Choosing a topic leads to a screen containing a menu of sub-topic choices. Selection of a sub-topic item results in the display of an information screen (such as local cinema features) or a screen requiring user

actions (such as E-mail or banking transactions). Experimental users explore the system at their own pace for a fixed period of time at which point the software interrupts their exploration and presents final instructions.

The system is designed to provide a consistent "look and feel" across topics, screens requiring action, and information displays (called frames). System functions are designed to be performed with simple directions and a minimum number of keystrokes. The system ignores keystrokes not relevant to the context displayed. The administration and timing of instructions and activities is managed completely by the simulation system using the internal system clock. Thus, consistency of exposure across subjects and conditions can be attained.

Figure 1 shows the layered software configuration of the *INFOSERVE* system. The kernel of the system comprises a Simulation Engine which provides the basic system functions such as retrieving and displaying information frames, monitoring users' keystrokes, and sequencing events. This kernel is surrounded by two shells which control different aspect of the simulation.

Figure 1 About Here

The Session Driver manages an individual experimental session. Functions include monitoring the length of the

session, displaying the system logo, and presenting general instructions to the user. This component also maintains a unique session data identifier and logs user actions. The Configuration Driver controls the system configuration thereby managing the experimental manipulations. For example, this software element determines from which of several databases the graphic textual information frames are taken.

Figure 2 illustrates the system architecture of the *INFOSERVE* methodology. Note that the information presented by the system; that is, audio clips, images, and text frames; is maintained in a "content base" which is independent of the presentation mechanism. This design facilitates easy modification and updating of the information content.

Figure 2 About Here

Content Choices. In this set of experiments, subjects were able to select ten different main topic categories with five sub-categories within each main category. The main categories included entertainment choices (e.g., humor), information choices (e.g., weather), and utility functions (e.g., banking, E-mail). The topic choices ranged in degree of user participation from one-way communication (e.g., weather, sports scores) to moderate user involvement (e.g., in the humor category users could contribute their own

jokes) to complete interactive communication (e.g., E-mail). Also, in order to minimize gender bias, care was taken to select some topics and subtopics which might appeal more to females and some with greater male appeal. Preliminary analysis of data showed that many of the males selected sports scores, while females were drawn more to shopping. Most other topics appeared, through usage data, to be gender neutral.

Appendix I illustrates the topics and sub-topic options used in one version of the simulation. Some information frames, such as weather reports and sport scores, required daily updating. Others remained constant across experimental sessions. Topic choices of a personal nature, such as bank account balances and read electronic mail, presented a hypothetical, but realistic scenario.

Manipulations. Several experimental manipulations have been employed in studies using the *INFOSERVE* system. Some examples are described here. Effects of hedonic aspects of CMC were investigated by factorially varying the presence of color, graphics, and music. In the "graphics present" conditions, a two-second graphic image relevant to a sub-topic appeared just after that sub-topic was selected and before the succeeding information screen appeared. In "music present" conditions, a thematically appropriate computerized tune was provided as a 10-second audio overlay with an information screen. For example, the weather report was accompanied by the tune "Rain drops keep falling on my

head". In the "color absent" condition, the otherwise multi-colored screens were presented in a monochrome format.

Care was exercised to keep system usage characteristics (other than the treatment) constant across all treatments. For example, in the "no graphics" conditions, a screen which read "PLEASE WAIT" appeared for exactly the same time that a graphic image would appear, thus keeping exposure time constant across these two classes of treatments.

Dependent Measures

Online Measures. To attain an entirely unobtrusive record of subjects' choices, the software was designed to record and timestamp each selection made by each individual subject. This generates a log of the pattern and duration of all user actions and choices -- a data set which provides a level of precision and detail inconceivable for conventional observation techniques. For 165 subjects, spending 15 minutes each with *INFOSERVE*, the system captured 6585 unique user actions. Subjects were completely unaware of this aspect of measurement. External validity was thus extremely high, precluding the usual artifacts of offline self-report measurement as discussed by Anderson and Field (1991, see above).

Offline Measures. Once notified by the system that the session had ended, subjects completed a set of questions assessing their reaction towards the system. Subjects were asked to record their impressions on a number of Likert-type scales tapping various dimensions of their reactions and

impressions. While this portion of the experiment could be easily administered online, it was decided that online measurement would detract from the realism of the simulation.

Illustrative Results

This section provides a brief illustration of some of the analyses which are possible under this research approach. Thorough analyses of the experimental data are provided elsewhere (Mundorf, Westin & Dholakia, 1992; Mundorf, Westin, Brownell & Dholakia, 1992).

The subject activity data which is captured by the *INFOSERVE* system provides a variety of user preference metrics which are infeasible with traditional techniques. One measure of user preference is aggregate time spent with a topic. Aggregate time is, in effect, the user's "investment" in the topic area.

Among the ten main topics (see Appendix I), subjects spent the most time with humor (224.9 seconds, on average), followed by singles (89.6 seconds) and sports (71.9 seconds). Males spent more than twice as much time with sports scores (98.9 seconds) than did females (45.1 seconds). Shopping revealed the reverse pattern; females spent 50.3 seconds, while males invested only 33.8 seconds. Both of these gender differences were significant at the 0.01 level.

Topic preferences can also be measured by examining the first choice of topics. Sports was chosen first by 25.0% of

the subjects, followed by humor at 19.4%. Most subjects preferred to delay exploration of the more functional topics, such as banking (1.9%) and E-mail (1.9%).

A broad range of behavior is illustrated by the time taken to select the initial topic choice from the main menu. The range is from 10 to 61 seconds. Females appeared more conscientious, taking 24.5 seconds on average, compared to 19.7 for males. This difference is significant at the 0.004 level.

Potential New Analyses

Thorough analysis of these user activity data will provide numerous possibilities. To name just a few:

1. Usage patterns can be clustered using a pattern-matching algorithm. This may reveal new "types" of information service users, such as "browsers" or "topic concentrators." Patterns can be based on sequence, timing, or both.
2. Usage profiles can be tied-in with self-report measures of liking, enjoyment, interest, or intention to use to provide a better understanding of user needs and wants.
3. Also, usage profiles can be correlated with individual difference measures. These include personality scales (e.g., Sensation Seeking), measures of attitudes, familiarity with and ownership of technologies, and demographic information.

ADVANTAGES AND LIMITATIONS

Experimental simulation of an interactive information service in a laboratory setting not only permits the user to explore a variety of communication and information choices, but also allows exact measurement of each user's activity while exploring the system. In addition, usage patterns can be related to key demographic and psychographic variables.

The main advantage of this research method derives from the control possible while retaining realism and, hence, external validity. Selection of subjects, their moods and predispositions, pre- and post-measurements, content and format offered in an experimental condition, and response latency of the system -- these can all be varied to suit specific research objectives. Simulation-based experiments are a flexible method to explore and study many facets of CMC and other screen-based services.

Although the simulation offered by INFOSERVE was realistic as ascertained by exit interviews of subjects, the fact remains that it is a rough approximation of the commercially available services. Even if the content and format are designed to replicate a commercial service, the research setting cannot replicate the home or office conditions under which CMC and other information services are used. Hence, simulation-based experiments should be used prior or parallel to field studies, especially as a way of exploring in a more detailed fashion the reasons why people respond to CMC and other information services the way they do. This experimental format can be particularly useful in

assessing the impact of potential content and format changes and of policies designed to regulate CMC and information services.

CONCLUDING REMARKS

We have presented a simulation-based experimental methodology for investigating user interactions with screen-based information services. The methodology entails simulation of computer-mediated communications in a prototypical format, devising experimental treatments consistent with the research objectives at hand, and measuring user interactions and responses both offline and online.

In an era when computer-mediated communications and information services are expanding, such a research methodology offers several advantages. It is versatile and can be tailored to specific research objectives of commercial as well as academic nature. Although prototypical simulations may lack the realism of a fully-configured CMC system or information service, such simulations provide results that are robust enough as far as overall patterns of user acceptance and reaction are concerned. With the appearance of new software packages such as Microsoft's *Visual Basic*, it is possible to create high-fidelity prototypes at relatively low costs. Unlike a real online system, these prototypes can be experimentally

manipulated in a versatile manner to meet specific research goals.

A particularly attractive part of the methodology is the online and unobtrusive capturing of usage data. This approach yields precise data without the errors associated with offline, self-reported measurement. Experimental artifacts and demand characteristics associated with traditional types of media research are minimized (cf. Wimmer and Dominick, 1991). Online data collection also shortens the data collection and analysis cycles; some of the simpler types of analyses and reporting of results could be accomplished in a real-time framework.

Future research using this methodology could proceed along several dimensions. With high-fidelity prototypes, especially those employing animated graphics, it should be possible to devise experimental methodologies that would be interesting enough to involve children and young adults weaned on videogames and music television. Employing portable computers and simpler interface devices such as reduced keyboards, touch screens, or voice-response systems, it might be possible to take the methodology into busy field locations where "people on the street" can be subjects of a study.

Several extensions are possible in terms of the types of data collected and the methods of analysis employed. Possible dependent variables could be topic usage patterns, message contents and structures, as well as several measures

of acceptance of and affect toward the system. Potential predictor variables could include technology usage characteristics, overall and specific personality measures, attitudes, and demographics. The authors hope the methodology outlined in this paper spawns future research along some of these dimensions.

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APPENDIX I

TOPICS AND SUB-TOPICS

Note: Sub-topic choices are either interactive (I), or passive (P) on the part of the user.

WEATHER REPORT	
5-DAY LOCAL FORECAST	(P)
5-DAY NATIONAL FORECAST	(P)
TRAVEL WEATHER - US	(P)
TRAVEL WEATHER - INTERNATIONAL	(P)
MARITIME CONDITIONS	(P)
SPORTS UPDATE	
FOOTBALL	(P)
BASKETBALL	(P)
BASEBALL	(P)
HOCKEY	(P)
ATHLETE OF THE YEAR	(P)
SINGLE SCENE	
ADS BY MEN	(P)
ADS BY WOMEN	(P)
WHERE TO MEET	(P)
WHAT TO DO	(P)
PLACE YOUR OWN PERSONAL AD	(I)

HUMOR

SEX	(P)
PEOPLE	(P)
NONSENSE	(P)
MISCELLANEOUS	(P)
TELL YOUR OWN JOKE	(I)

BANKING

YOUR ACCOUNT BALANCE	(P)
YOUR CREDIT CARD BALANCE	(P)
PAY YOUR BILLS	(I)
TRANSFER FUNDS BETWEEN ACCOUNTS	(I)
BANKING INFORMATION	(P)

ELECTRONIC MAILBOX

READ MAIL	(I)
WRITE MESSAGE	(I)
BULLETIN BOARD	(I)
LIST OF CONFERENCES	(P)
WRITE TO A CONFERENCE	(I)

TRAVEL INFORMATION

US & CANADA	(P)
MEXICO & CARIBBEAN	(P)
SOUTH AMERICA	(P)
EUROPE & AFRICA	(P)
ASIA & AUSTRALIA	(P)

ENTERTAINMENT

MUSIC	(P)
CINEMA	(P)
THEATER	(P)
CHILDREN	(P)
RESTAURANTS	(P)

JOB MARKET

CLERICAL	(P)
RESTAURANTS	(P)
SALES	(P)
MEDICAL	(P)
PLACE YOUR OWN AD	(I)

SHOPPING

CLOTHING	(P)
ELECTRONICS	(P)
VIDEO	(P)
BEAUTY AIDS	(P)
AUDIO	(P)

TABLE 1

A COMPARISON OF COMMUNICATION TECHNOLOGIES

CHARACTERISTIC	TELEVISION	TELEPHONE	CMC
REACH OF COMMUNICATION	Mass	Interpersonal	Mass, interpersonal, or small group
TIME FRAMEWORK	Synchronous (exception: VCR time-shifting)	Synchronous (exception: voice mail)	Asynchronous or synchronous
TARGETING OF COMMUNICATION	Low	Very high	Medium to very high
SENDER'S CONTROL OVER SELECTIVE EXPOSURE	Moderate	Very high	Very low
RECEIVER'S CONTROL OVER SELECTIVE EXPOSURE	Moderate	Moderate	High
MANIPULATION AND EDITING OF MESSAGES BY RECEIVER	Very little (exception: "zapping")	Almost none	Very high
CUSTOMIZATION OF CONFIG./ FORMAT BY RECEIVER	Low	Almost none	High
EASE OF STORING RECEIVED MESSAGES	Moderate	Low	High
NATURE OF INTERACTION	Standard	Highly idiosyncratic	Unique and moderately idiosyncratic

Figure 1

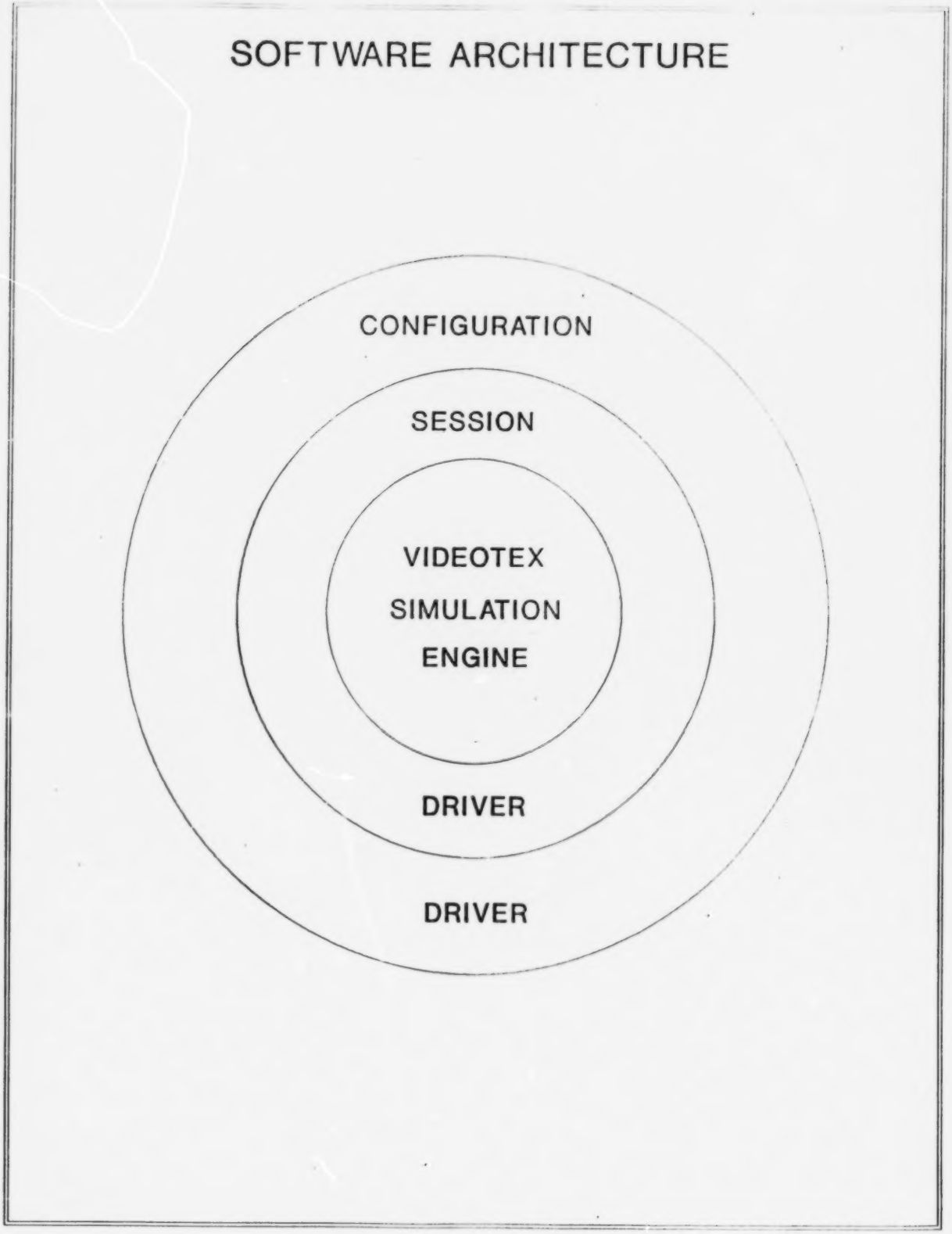
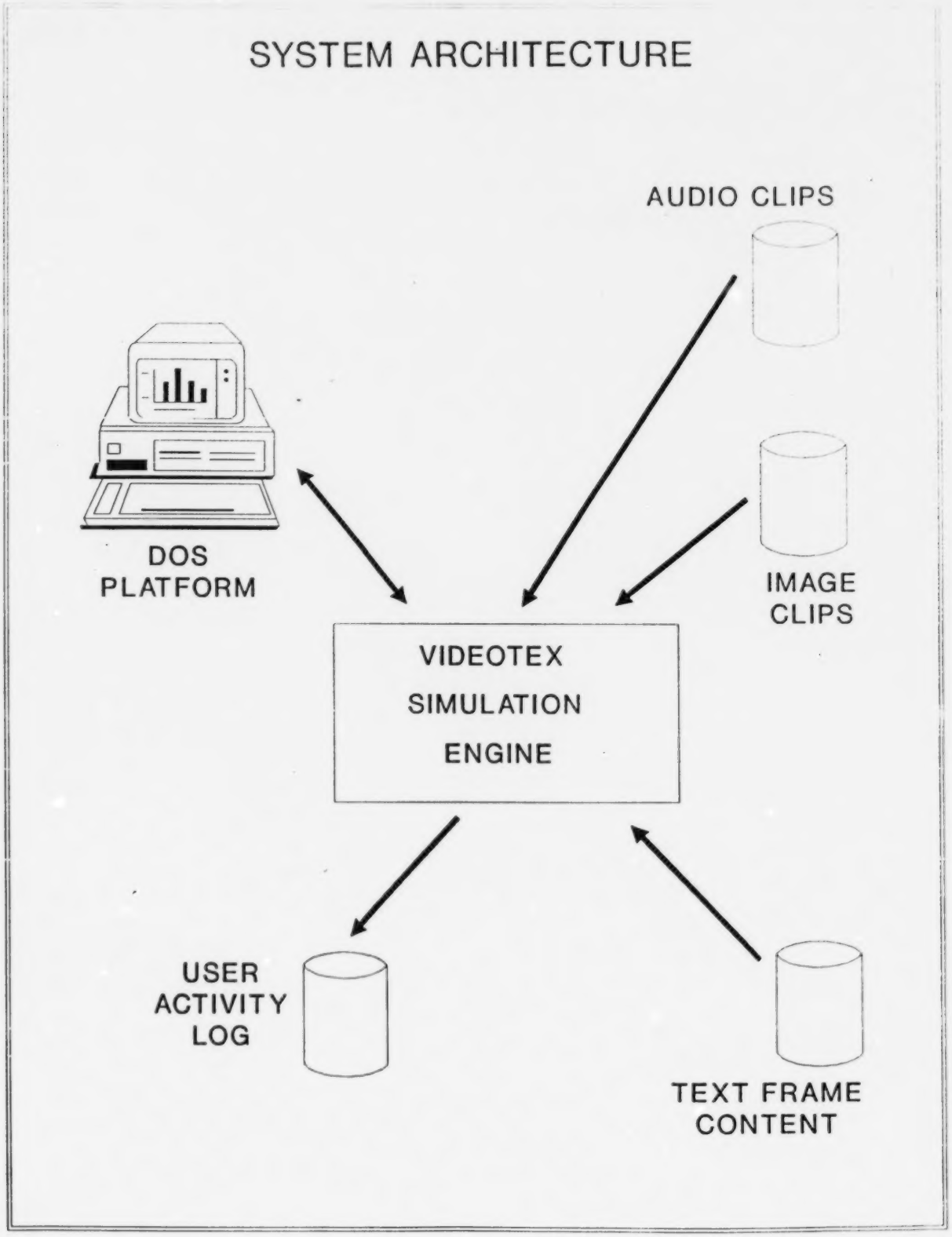

SOFTWARE ARCHITECTURE
CONFIGURATION
SESSION
VIDEOTEX
SIMULATION
ENGINE
DRIVER
DRIVER

Figure 2


SYSTEM ARCHITECTURE
AUDIO CLIPS
DOS
PLATFORM
IMAGE
CLIPS
VIDEOTEX
SIMULATION
ENGINE
USER
ACTIVITY
LOG
TEXT FRAME
CONTENT